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APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTOR: John E. Herbst  
Howard L. Danzyger

TITLE: INPUT DEVICE FOR SCROLLING A  
COMPUTER DISPLAY

ATTORNEY: Timothy P. Lucier  
Registration # 44,882  
BRINKS HOFER GILSON & LIONE  
P.O. BOX 10395  
CHICAGO, ILLINOIS 60610  
(312) 321-4200

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## INPUT DEVICE FOR SCROLLING A COMPUTER DISPLAY

### BACKGROUND OF THE INVENTION

The present invention generally relates to computer input devices. In particular, the invention relates to computer mice having input apparatus, such as a scroll wheel or a track ball, for scrolling a computer display.

It is commonly known to computer users that Windows based operating systems, such as Windows by Microsoft Corporation, and the applications that run under them, may only display a portion of a document or computer program on a display screen if the viewable area of the document or program is larger than the viewing area of the display screen. In this situation, a user must scroll through the document or program to view the entire document or program. Depending on the size and orientation of the viewable area of a document or computer program, the user may need to scroll in a vertical and/or horizontal direction. While scrolling may be accomplished by using software scroll bars generated by the windows based application, computer mice having scroll wheels or track balls may also be used to input scrolling commands.

Computer mice having scroll wheels are well known in the art. Scroll wheels are generally finger operated rotatable discs that protrude from a surface of the computer mouse. Typically, the scroll wheel is located between the two buttons of a conventional two button mouse and can be operated by the index finger. Although capable of performing many functions, scroll wheels are particularly useful for providing a user with a convenient and efficient way for inputting scrolling commands. Finger operated track balls have also been used to input scrolling commands and provide the added benefit of generating simultaneous vertical and horizontal scrolling inputs.

Prior art computer mice with scroll wheels or track balls allow a user to scroll a display at a rate relative to the rate of rotation of the scroll wheel or track ball. If a user rotates the scroll wheel quickly, the display screen also scrolls quickly. A variable and rapid scroll rate, however, can result in somewhat unpredictable movement of the viewed section of the document.

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Due to rapid movement of words and images on the display screen a user may become confused as to where he or she is in a particular document. This can result in inefficient computing.

## BRIEF SUMMARY OF THE INVENTION

The preferred embodiment of the present invention addresses these short comings of the prior art by providing a smooth, constant scroll rate, independent of the rate of rotation of the scroll wheel. Scrolling of a document is therefore constant and predictable.

In one aspect, the invention provides a graphical display scrolling system made up of an apparatus for displaying viewable elements of a graphical display and an input device with a rotatable element. Rotation of the rotatable element causes the viewable elements of a graphical display to scroll at a rate that is constant and independent of the rate of rotation of the rotatable element. The apparatus is generally a computer but may be any apparatus that processes and displays graphical information.

In another aspect, the invention provides an input device that has a rotatable element, a motion signal generator, a motion signal interpreter and a software driver. The motion signal generator detects motion of the rotatable element and generates motion signals. The motion signal interpreter checks for generation of motion signals within predetermined periods of time. If at least one motion signal is detected within the predetermined period of time, the motion signal interpreter generates one output signal at the end of the predetermined period of time. When the software driver receives an output signal, the software driver generates a line scrolling command to scroll the graphical display. The scrolling rate of the graphical display is constant when the rotatable element is rotated.

Advantages of the present invention will become more apparent to those skilled in the art from the following description of the preferred embodiments of the invention which have been shown and described by way of illustration. As will be realized, the invention is capable of other and different embodiments, and its details are capable of modification in various

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respects. Accordingly, the drawings and description are to be regarded as illustrative in nature and not as restrictive.

## BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is an external perspective view of the preferred embodiment of the present invention.

FIG. 2 is an internal perspective view of the preferred embodiment of the present invention while connected to a computer.

FIG. 3 is an external perspective view of another preferred embodiment of the present.

FIG. 4 is a schematic illustrating the components of the motion signal interpreter of the preferred embodiment of the present invention

FIG. 5 is a flow diagram illustrating the components of the preferred embodiment of the present invention and the flow of data through the components.

## DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS OF THE INVENTION

Turning now to the drawings, FIG. 1 depicts an input device 10 having a rotatable element 20 that protrudes through the top cover 18 of the device 10. The rotatable element 20 is preferably a scroll wheel. As illustrated in FIG. 3, the rotatable element 20 may also be a finger operated track ball.

The input device 10 also preferably comprises at least one finger operated button 16 located on the external housing of the device 10.

FIG. 2 is a perspective view showing the internal components forming the input device 10 according to one preferred embodiment of the invention. In this embodiment the input device 10 comprises a roller ball 12 for x,y cursor positioning on a computer display screen. One skilled in the art will recognize that although a roller ball 12 is shown in the preferred embodiment, x,y cursor positioning may also be achieved through other positioning apparatus such as an optical sensor located on the bottom of the input device 10 that measures changes in surface features or through other inputs devices such as a palm operated track ball or a joystick.

The preferred embodiment of the present invention further comprises at least one microswitch input **14** that corresponds to at least one finger operated button **16** so that depression of the button **16** activates the microswitch input **14**. The button **16** and microswitch input **14** provide additional functionality to allow a user to select and manipulate objects and text within a computer program. Preferably, the input device **10** has two finger operated buttons **16**, although it may also have three or more finger operated buttons.

The rotatable element **20** is used to translate rotational inputs from a user's finger into scrolling commands on the display. Preferably, the rotatable element **20** is located on the top surface of the input device and is designed to be easily accessible to the user. It is to be understood, however, that the rotatable element **20** can be located on the input device at any location that may be convenient for the user. For example, the rotatable element **20** may be located on the side or the bottom of the input device. In one embodiment of the present invention, the rotatable element is located between two input buttons **16** at the forward section of the input device **10**. As illustrated in FIGS. 1 and 2, the rotatable element **20** can be a scroll wheel. A finger operated track ball, as shown in FIG. 3 however, may also be used for inputting scrolling commands.

In an additional embodiment of the present invention, the rotatable element **20** may also be the roller ball of the input device. In this embodiment, motion of the input device across a surface provides rotational input to the roller ball. The direction of this rotational input can be used to generate scrolling commands. Preferably, the input device described herein also has a finger operated track ball to provide x,y cursor positioning. In this embodiment, x,y cursor positioning is inputted through rotation of the track ball and scrolling is inputted through motion of the input device, which, consequently, results in rotational motion of the roller ball. One skilled in the art would understand that an optical sensor may also be used in place of the roller ball for inputting scrolling commands.

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In a preferred embodiment, the scroll wheel provides one dimensional input of scrolling commands where backward and forward turning of the scroll wheel results in scrolling a computer display in either a vertical or horizontal direction. In this embodiment, the rotatable element **20** comprises an elastomer outer ring **22** for providing enhanced gripping features and a rigid inner hub **24** for supporting the outer ring **22**. The rotatable element **20** is connected with an axially mounted spindle **26** supported by one or more vertical support structures **28** that allow free rotation of the rotatable element **20** about the spindle **26**.

In another embodiment of the present invention, the rotatable element **20** is a finger operated track ball as best seen in FIG. 3. In this embodiment, rotation of the track ball results in two dimensional scrolling where left/right and forward/backward rotation of the trackball allows inputs for simultaneous vertical and horizontal scrolling of a computer display.

The device of the present invention further comprises a motion signal generator **30** and a motion interpreter **40**. A motion signal generator **30** is preferably located proximate to the rotatable element **20** and is responsive to motion of the rotatable element **20**. The motion signal generator **30** detects rotational motion of the rotatable element **20** and generates a motion signal in response. Preferably, the motion signal generator **30** is a rotary contactor located on a vertical support structure **28**. The rotary contactor is connected with the spindle **26** and is responsive to motion of the spindle **26**. When the rotatable element **20** is rotated, the spindle rotates **26** the rotary contactor, generating electrical motion signals. These motion signals are then transmitted to the motion interpreter **40**. Although the motion signal generator **30** is disclosed as a rotary contactor in FIG. 2, one skilled in the art would recognize that other apparatus, such as an optical encoder, may also be used for detecting rotary motion and generating responsive motion signals.

The motion signal interpreter **40** is in communication with the motion signal generator **30** for receiving motion signals. The motion signal interpreter **40** is capable of reading motion signals and is in the nature of an integrated circuit with a memory module. Referring to FIG. 4, the motion signal

interpreter **40** preferably comprises a memory buffer **42**, a timer **44**, a comparator **46**, and an output signal generator **48**. Motion signals received by the motion signal interpreter **40** are stored temporarily in the memory buffer **42**. The timer **44** is a device that measures predetermined periods of time. In the preferred embodiment, the timer **44** measures a predetermined period of time between about 1 and about 300 milliseconds, preferably between about 10 and about 50 milliseconds, and more preferably between about 15 and about 25 milliseconds. The comparator **46** is in communication with both the memory buffer **42** and the timer **44**. At the end of a predetermined period of time, as measured by the timer **44**, the comparator **46** checks the memory buffer **42** to see if a motion signal has been sent to the memory buffer **42** within a previous predetermined period of time. If a motion signal has not been received, the comparator **46** waits until the next predetermined period of time passes before checking the memory buffer **42** again. If one or more motion signals have been received within the previous predetermined period of time, the comparator **46** instructs the output signal generator **48** to generate one output signal.

A software driver in communication with the input device **10** is capable of receiving output signals from the motion signal interpreter **40** and generating line scrolling commands in response to reception of the output signals. The software driver communicates with an apparatus that processes and displays graphical information such as a computer, a graphical interface to the Internet, or a graphical interface to another network. For convenience the apparatus will be described as a computer, however, one skilled in the art will understand that the any of the embodiments listed above may also be used. In one embodiment, the apparatus is a computer **60** operating a computer program **62** that generates a graphical display on the computer display screen **64**. The software driver is preferably resident on the computer **60** and communicates with the computer program **62**. The computer program **62** is responsive to the software driver such that line scrolling commands generated by the software driver cause the viewable portion of the graphical display to scroll on the computer display screen **64**.

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In operation, a user who wishes to scroll a graphical display rotates the rotatable element 20 of the input device 10. As shown in FIG. 5, the motion signal generator 30 monitors the rotatable element 20 for rotation. When the motion signal generator 30 detects rotation of the rotatable element 20, the motion signal generator 30 generates motion signals and transmits the motion signals to the motion signal interpreter 40. At the end of a predetermined period of time, the motion signal interpreter 40 checks if one or more motion signals has been sent within the previous predetermined period of time. In the preferred embodiment, the predetermined period of time is between about 15 milliseconds and about 25 milliseconds. If a motion signal is not received within the predetermined period of time the motion signal interpreter 40 waits for another predetermined period of time to pass until it checks again for reception of a motion signal. Alternatively, if one or more motion signals were received within the previous predetermined period of time, the motion signal interpreter 40 generates one output signal and transmits it to the software driver 50.

In a preferred embodiment of the motion signal interpreter 40, a memory buffer 42 temporarily stores the motion signals from the motion signal generator 30. The comparator 46 monitors the timer 44 and waits for the predetermined period of time to pass. At the end of the period, the comparator 46 checks the memory buffer 42 to see if a motion signal has been sent within the previous predetermined period of time. If the memory buffer 42 has not received a motion signal within the previous predetermined period of time, the comparator 46 waits for the end of the next predetermined period of time to again check the memory buffer 42 for motion signals. If the comparator 46 sees that one or more motion signals have been received by the memory buffer 42 within the previous predetermined period of time, the comparator 46 instructs the output signal generator 48 to generate one output signal for transmission to the software driver. A maximum of one output signal is generated per predetermined period of time regardless of the number of motion signals received within the previous predetermined period of time. The memory buffer 42 is then cleared of motion signals.

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The software driver **50** continuously monitors for the reception of an output signal. If an output signal is received, the software driver **50** generates a line scrolling command. The line scrolling command is transmitted to the computer program **62**, causing the viewable elements of the graphical display to line scroll on the display screen **64**.

The above operation results in a constant scroll rate, independent of the rate of rotation of the rotatable element. Only one output signal, and therefore only one line scrolling command, is generated at the end of the predetermined period of time, without regard to whether several motion signals were received within that previous predetermined period of time.

While preferred embodiments of the invention have been described, it should be understood that the invention is not so limited and modifications may be made without departing from the invention. The scope of the invention is defined by the appended claims, and all devices that come within the meaning of the claims, either literally or by equivalence, are intended to be embraced therein.

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